Status Report: Run 3 Electron Reconstruction Studies

Furkan Cetin

Heidelberg University

cetin@physi.uni-heidelberg.de

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Motivation

- electrons heavily emit bremsstrahlung
- electron track-finding underperforms compared to other particles

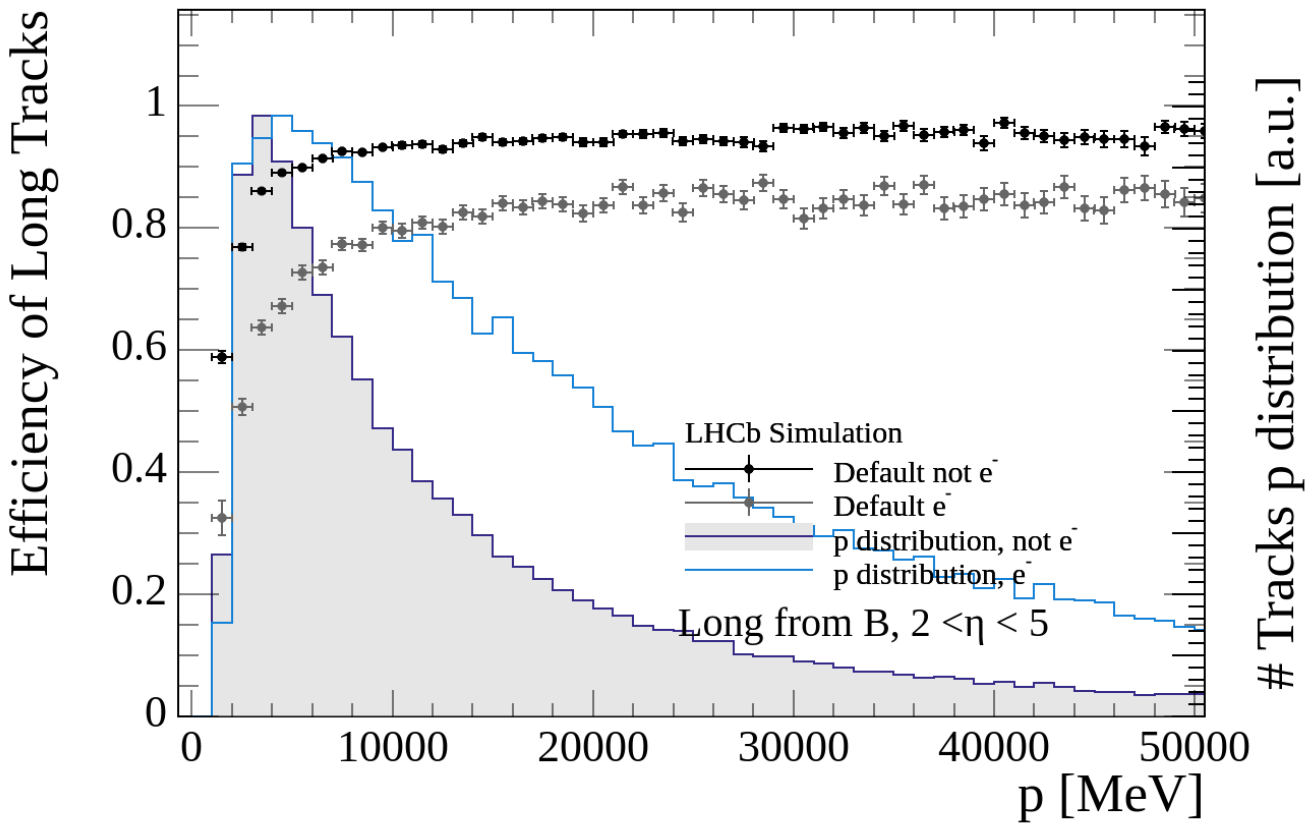

Figure: BestLong Efficiency of electrons and not-electrons

Problem

1. momentum spectrum of electrons is skewed
   - actual (effective) momentum is often lower because of strong radiation in VELO
   - lower momentum particles' tracking is less efficient
2. bremsstrahlung after the VELO mainly obstructs reconstruction

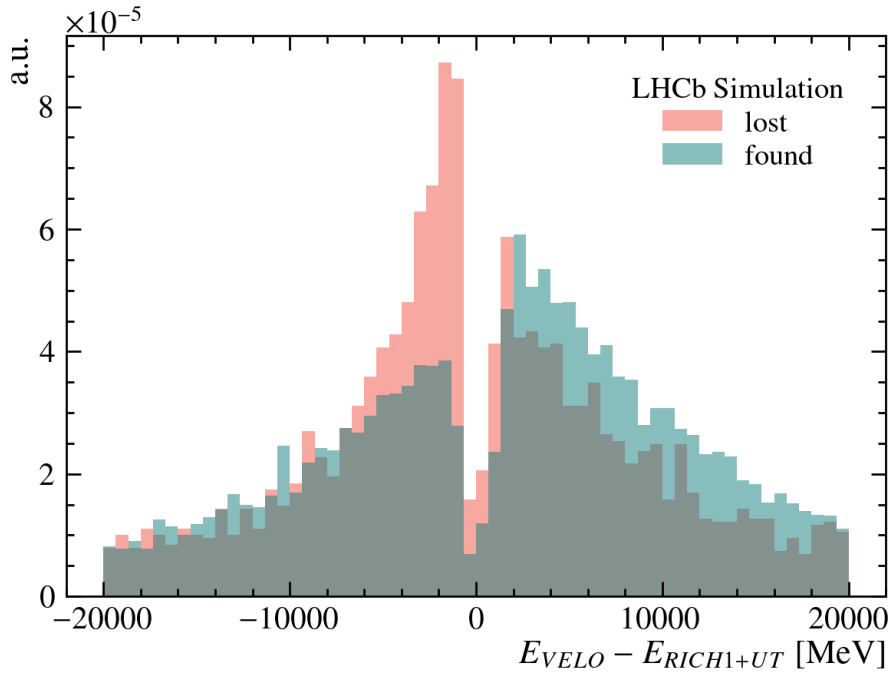

Figure: difference in amount of energy emitted upstream in the VELO and after the VELO for the $B^0 \to K^* e^+ e^-$ decay

Fix

- redefine the momenta p and p_T of electrons that are used to illustrate efficiencies in `PrTrackCounter.cpp` for MC particles
- use momentum at $z = 770\,\text{mm}$ (EndVelo) instead of at creation

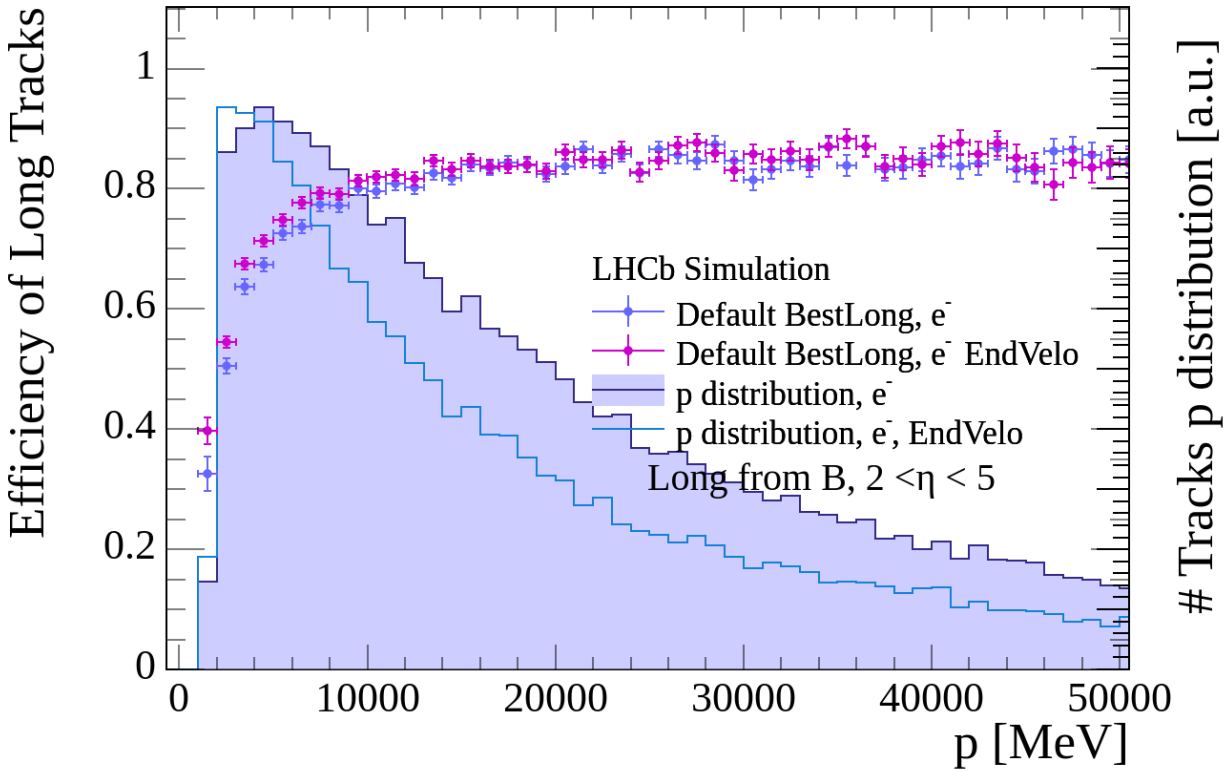

Figure: Efficiency for electron BestLong tracks using current and new momentum definition

Radiation Length Fraction

$$\langle E \rangle = E_0 \exp\left(x/X_0\right)$$

- probability for bremsstrahlung increases when traversing through material
- is there a way to estimate the energy loss of electrons using geometric variables
  - i.e. correlation to η or ϕ

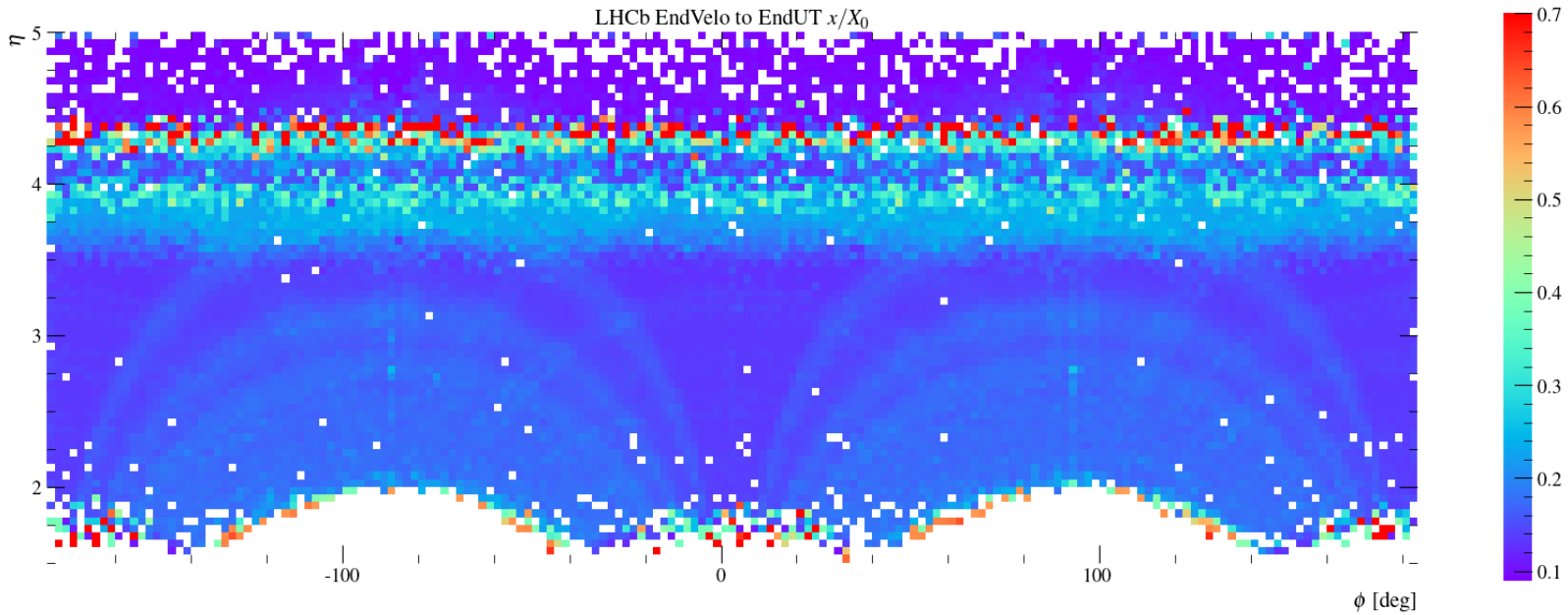

Figure: Radiation length fraction as a function of η and ϕ

Radiation Length Fraction

- not as much separation as anticipated for lost and found electron tracks

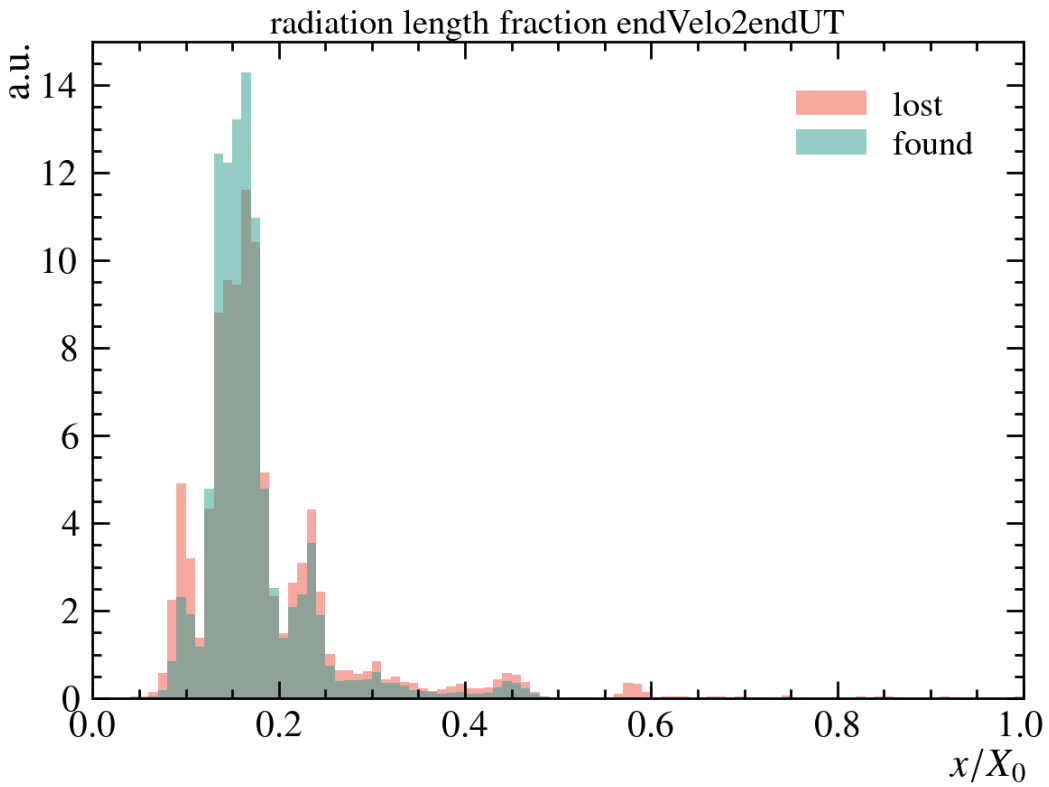

Figure: Radiation length fraction distribution for lost and found electrons

Conclusion

- redefining the momenta for electrons allows a better, more accurate, illustration of the efficiencies
- the radiation length fraction does not provide great separation between lost and found electrons

To do:

- look into other possible input variables, exploiting the detector geometry
- utilise ECAL cluster information to filter Seed tracks for electron Matching

Energy loss of electrons in the VELO

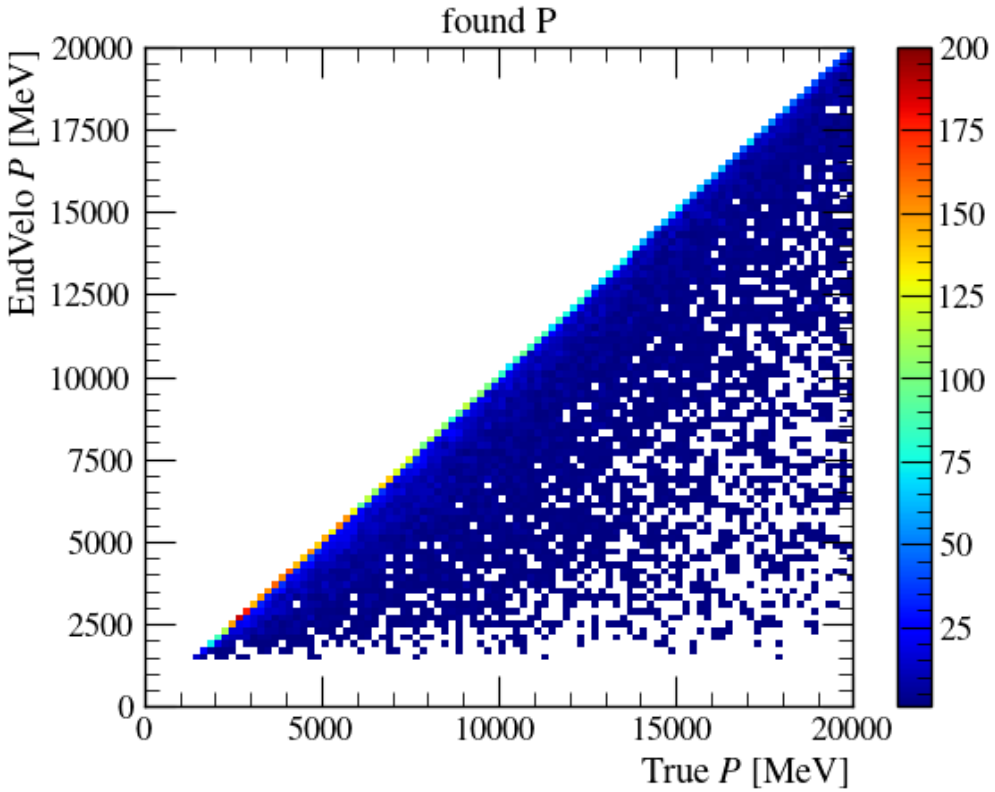

Figure: EndVelo$P$ vs. True$P$

EndUT Efficiency

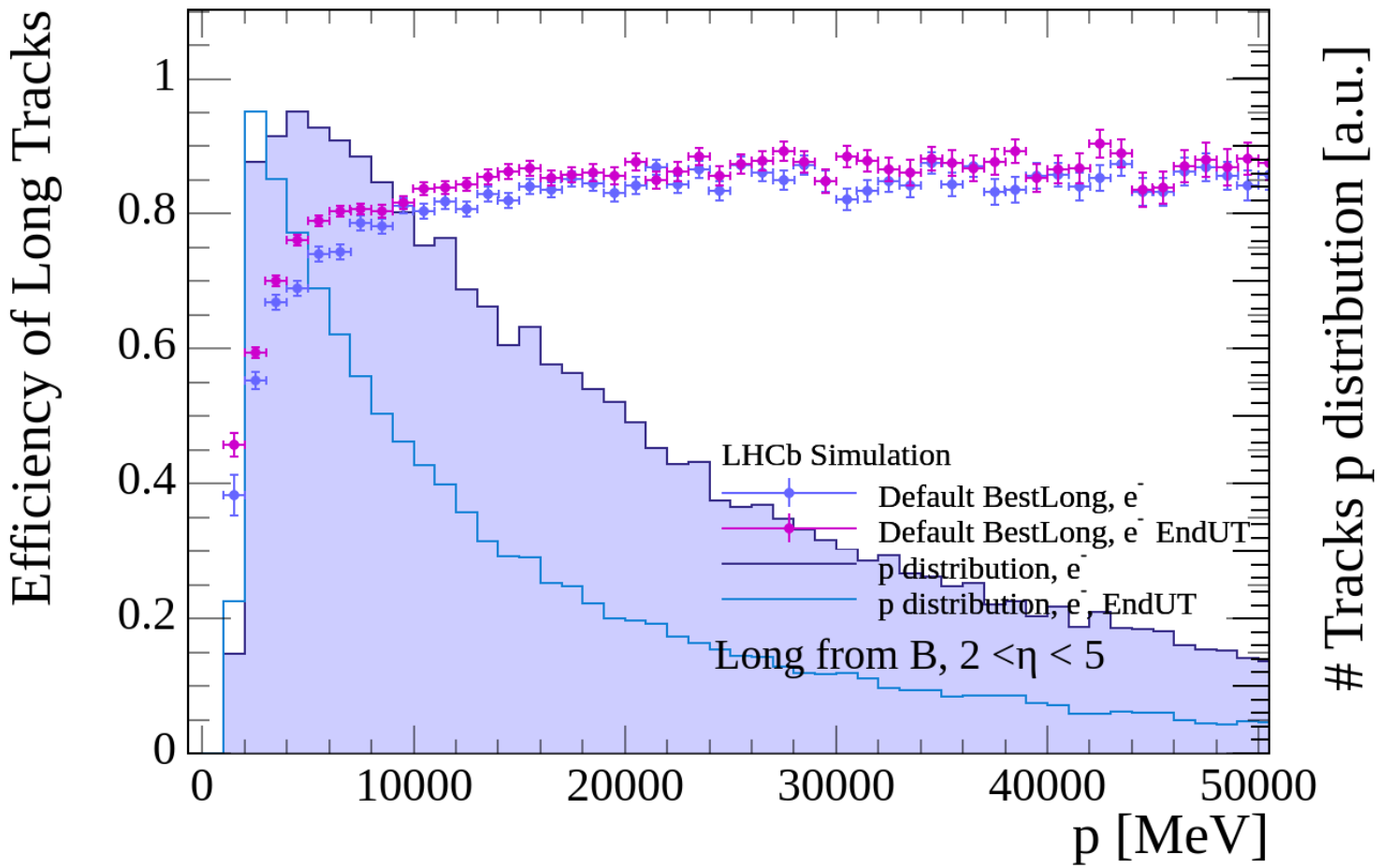

Figure: BestLong efficiency for momentum spectrum at EndUT

Radiation Length Fraction: BeginVelo to EndUT

- x/X_0 of all upstream sub-detectors

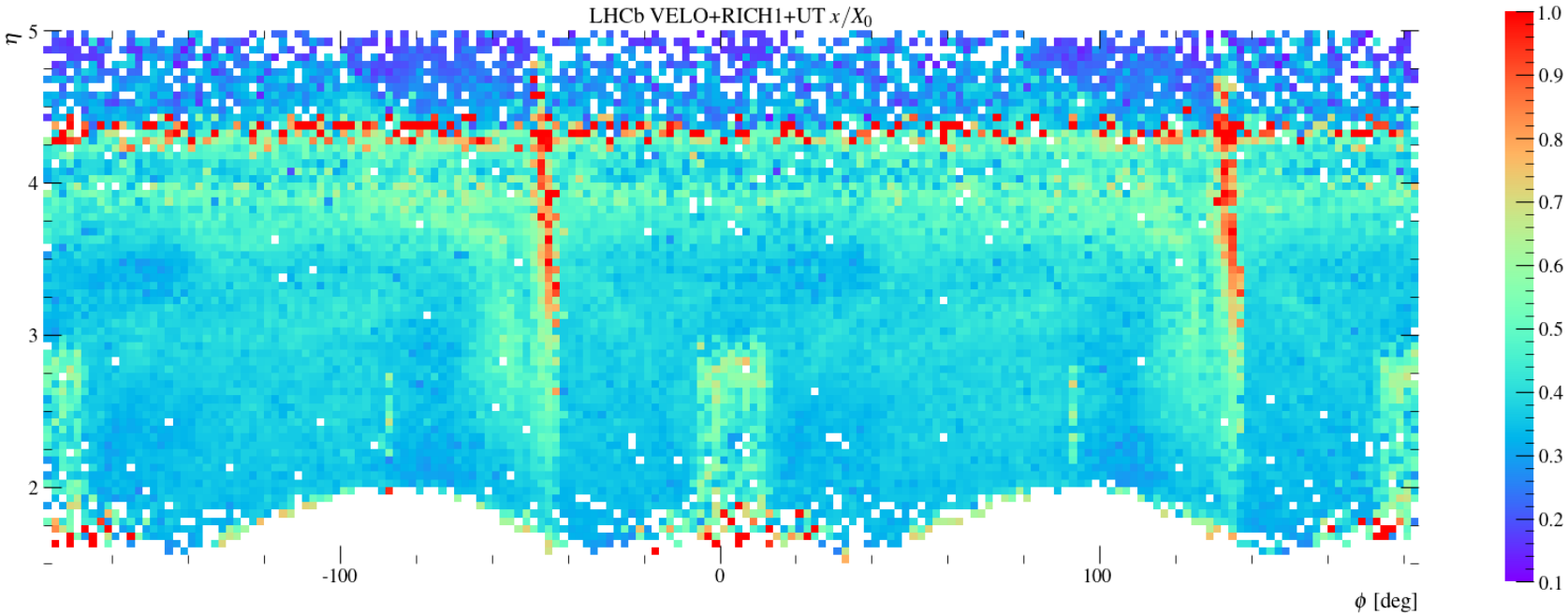

Figure: Radiation length fraction as a function of η and ϕ

Using Linear Regression to parametrise x/X_0

- first attempts at parametrising x/X_0 using linear regression also did not yield promising results

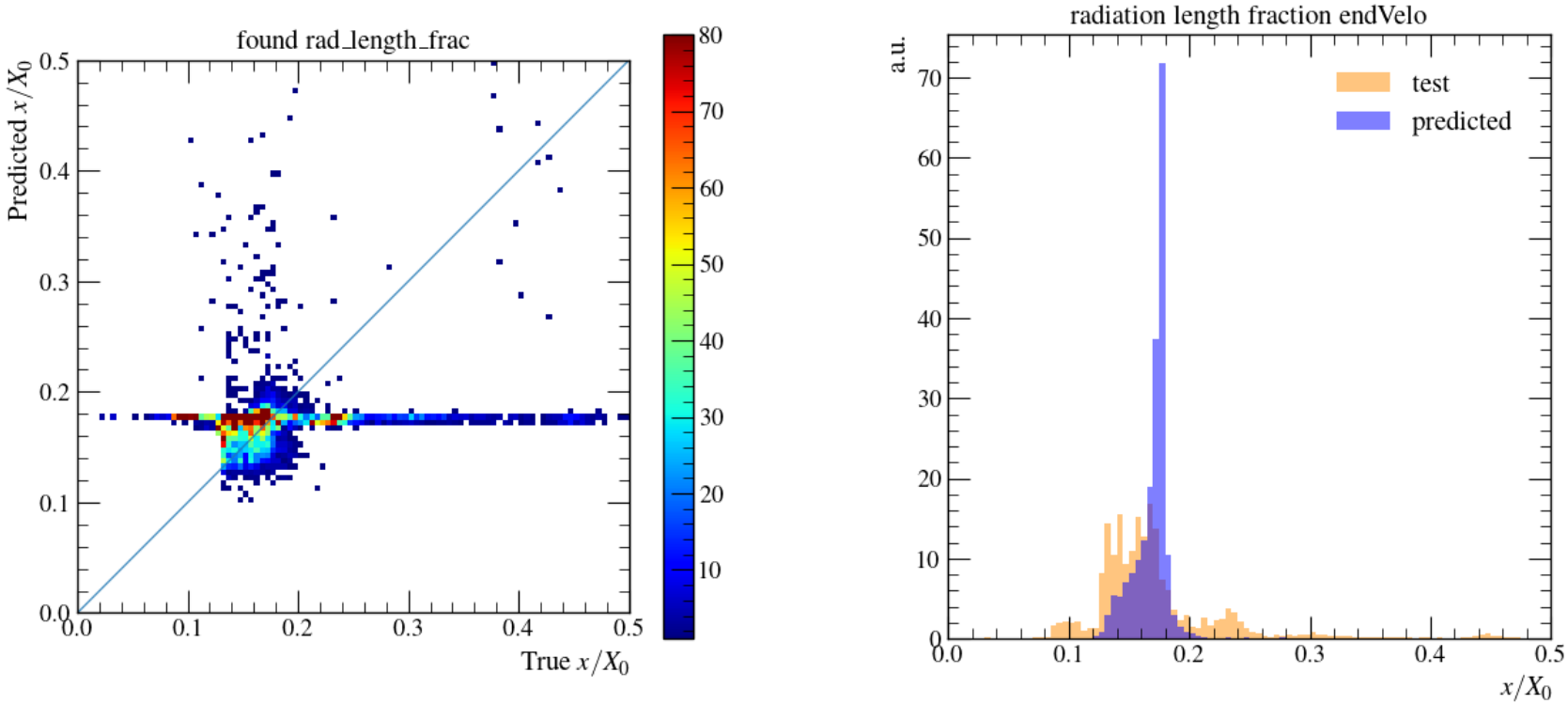

Figure: Radiation length fraction predicted and actual values